PATENT COOPERATION TREATY

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TITLE: Heat Spreader Constructions, Integrated Circuitry, Methods of Forming Heat Spreader Constructions, and Methods of Forming Integrated Circuitry

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AMENDMENT UNDER PCT ARTICLE 34

Applicant responds to the Written Opinion mailed 04 January 2006 with accompanying substitute pages 10-13, which Applicant requests be submitted into the application in place of the originally submitted pages 10-13.

Differences Between the Claims as Filed and the Claims as Amended by Substitute Pages 10-13

Claim 1 is amended;

Claim 2 is unchanged;

Claim 3 is amended;

Claims 4-14 are unchanged;

Claim 15 is amended;

Claims 16-19 are unchanged;

Claim 20 is amended;

Claims 21-24 are unchanged;

Claim 25 is amended; and

Claims 26-28 are unchanged.

Differences Between the Pending Claims 1-28 and the References Cited in the Written Opinion

As amended, claim 1 recites a heat spreader comprising two parts one of which is a frame portion comprising at least one material selected from a recited list of materials. The amendment incorporates materials recited in original claim 3. Not one of the cited references, or a combination thereof, discloses or suggests a frame portion comprising material(s) in the recited list. Accordingly, claim 1 is novel and inventive relative to the cited art.

Claims 2 and 4-14 are novel and inventive relative to the art of record for at least the reason that they depend from novel and inventive base claim 1.

Claim 3 is amended to place it in independent form and to additionally recite a metallic coating over at least a portion of a heat spreading surface, The amendment is supported by the application as originally filed at, for example, paragraphs 34-35. None of the cited references, considered individually or in combination, disclose or suggest the recited metallic coating. Accordingly, claim 3 is novel and inventive relative to the cited art.

As amended, independent claim 15 recites independently forming a heat spreader, the forming comprising joining a base portion and a frame portion. None of the cited references or any combination thereof, discloses or suggests

this recited methodology. Accordingly, claim 15 is allowable over the art of record. Dependent claims 16-19 are novel and inventive for at least the reason that they depend from novel and inventive base claim 15.

As amended, claim 20 recites a frame portion having materials selected from a recited list. Claim 20 and claims 21-24 which depend therefrom, are novel and inventive for at lest reasons similar to those discussed with respect to claim 1.

With respect to independent claim 25, such recites providing integrated circuitry with a mounted heat generating device, and subsequently mounting an independently-formed heat spreader. The heat spreader comprises a base portion joined to a frame portion. As discussed above, none of the cited art discloses or suggests the recited independently-formed heat spreader having a base portion and a frame portion. Accordingly, claim 25 is novel and inventive relative to the cited art.

Claims 26-28 are novel and inventive relative to the art of record for at least the reason that they depend from novel and inventive base claim 25.

For the reasons discussed above, pending claims 1-28 are believed to be novel and inventive relative to the art of record. Consideration of such reasons is requested during preliminary examination.

Respectfully Submitted,

Date: March 14, 2006 By: Jennifer J. Taylor

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CLAIMS

The invention claimed is:

1. A heat spreader construction comprising:

a base portion having a heat spreading surface comprising a heat-receiving region and a perimeter surface surrounding the heat-receiving region, the base portion comprising a first material; and

a frame portion comprising a second material and interfacing the perimeter surface, the frame portion having a thickness and having an opening traversing the thickness, the second material comprising at least one member selected from the group consisting of aluminum, aluminum alloys, composite carbon materials, diamond, ceramic materials, molybdenum, tungsten, KOVAR®, and heat-stable polymer materials.

2. The heat spreader construction of claim 1 wherein the first material comprises at least one member of the group consisting of copper, copper alloys, aluminum, aluminum alloys, composite carbon-carbon materials, SiC, carbon, graphite, diamond, diamond composite materials, and combinations thereof.

3. A heat spreader construction comprising:

a base portion having a heat spreading surface comprising a heat-receiving region and a perimeter surface surrounding the heat-receiving region, the base portion comprising a first material;

a metallic coating over at least a portion of the heat spreading surface; and

a frame portion comprising a second material and interfacing the perimeter surface, the frame portion having a thickness and having an opening traversing the thickness, the second material comprising at least one member of the group consisting of copper, copper alloys, aluminum, aluminum alloys, composite carbon materials, diamond, ceramic materials, molybdenum, tungsten, KOVAR®, and heat-stable polymer materials.

4. The heat spreader construction of claim 1 further comprising an interface material disposed between the frame portion and the base portion.

5. The heat spreader construction of claim 4 wherein the interface material comprises a member of the group consisting of an adhesive material and a solder material.

6. The heat spreader construction of claim 1 wherein the first material has a thermal conductivity of greater than 300 W/mk.

7. The heat spreader construction of claim 1 wherein the first material has a thermal conductivity of greater than 400 W/mk.

8. The heat spreader construction of claim 1 wherein the first material has a coefficient of thermal expansion of less than 9 ppm/K.

9. The heat spreader construction of claim 1 wherein the first material has a coefficient of thermal expansion of less than 6 ppm/K.

10. The heat spreader construction of claim 1 wherein the frame portion is in direct physical contact with the base portion.

11. The heat spreader construction of claim 10 wherein the base portion and the frame portion are joined by a diffusion bond.

12. The heat spreader construction of claim 1 further comprising a coating material over at least a portion of the heat spreading surface.

13. The heat spreader construction of claim 1 further comprising a coating material over at least a portion of the perimeter surface.

14. The heat spreader construction of claim 13 wherein the coating material is a metallic material.

15. A method of forming a heat spreader construction, comprising:

forming a base portion comprising a first material and having a first surface comprising a perimeter region surrounding a heat-receiving surface;

forming a frame portion comprising a second material; and

joining the base portion and the frame portion to form an independent heat spreader construction for subsequent incorporation into an integrated circuitry constructions.

16. The method of claim 15 wherein the joining comprises attaching the frame portion and the perimeter region, the attaching comprising at least one of soldering, diffusion bonding and application of an adhesive material.

17. The heat spreader construction of claim 15 wherein the first material comprises at least one member of the group consisting of copper, copper alloys, aluminum, aluminum alloys, composite carbon-carbon materials and diamond.

18. The heat spreader construction of claim 15 wherein the second material comprises at least one member of the group consisting of copper, copper alloys, aluminum, aluminum alloys, composite carbon materials, diamond, ceramic materials, molybdenum, tungsten and KOVAR®.

19. The method of claim 15 further comprising applying a metallic coating material over at least a portion of the first surface prior to the joining.

20. Integrated circuitry comprising:

a heat-generating device; and

a heat spreader construction in thermal communication with the heat-generating device, the heat spreader construction comprising:

a base portion having a heat spreading surface disposed in heat-receiving relation relative to the heat-generating device, the base portion having a perimeter surface surrounding the heat spreading surface; and

a frame portion interfacing the perimeter surface, the frame portion having a thickness and having an opening traversing the thickness, the frame portion comprising at least one material selected from the group consisting of aluminum, aluminum alloys, composite carbon materials, diamond, ceramic materials, molybdenum, tungsten, KOVAR®, and heat-stable polymer materials.

21. The integrated circuitry of claim 20 wherein the heat-generating device is a flip-chip.

22. The integrated circuitry of claim 20 further comprising a circuitry board, wherein the heat spreader is mounted to the circuitry board with an interface material comprising at least one of an adhesive and a solder.

23. The integrated circuitry of claim 20 further comprising an interface material disposed between the heat-generating device and the heat spreading surface.

24. The integrated circuitry of claim 20 further comprising a heat-sink in thermal communication with the heat spreader.

25. A method of forming integrated circuitry comprising:

providing an integrated circuitry board having a heat-generating device mounted thereon;

after providing the integrated circuitry board, mounting an independently formed heat spreader in thermal communication with the heat-generating device, the heat spreader comprising:

a base portion comprising a first material, the base portion having a heat-receiving surface and a perimeter region around the heat-receiving surface; and

a frame portion comprising a second material interfacing the perimeter region.

26. The method of claim 25 further comprising mounting the heat-spreader to the circuitry board utilizing at least one of an adhesive and a solder.

27. The method of claim 25 wherein the heat-generating device is a flip-chip.

28. The method of claim 25 further comprising providing a thermal interface material between the heat-generating device and the heat-receiving surface, the thermal interface material being selected from the group consisting of thermal grease, metallic thermal interface materials, phase-change materials, thermal gels, and indium alloys.